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TO: OWP Staff

THROUGH: ~~E.H. Bartsch, P.E., Director, Office of Water Programs~~
Robert W. Hicks, Acting Director, Office of Water Programs
Robert B. Taylor, P.E., Director, Division of Water Supply Engineering

FROM: M/DBP Team

SUBJECT: Water – Procedures – Water Sampling and Analysis – TOC Testing

The Disinfectants/Disinfection By-products Rule (D/DBPR) issued by the USEPA on December 16, 1998 contains requirements for TOC monitoring. The requirements apply to waterworks using surface water or groundwater under the direct influence of surface water regardless of population. The M/DBP Team is still working to incorporate the D/DBPR into the *Waterworks Regulations.* Virginia has not received primacy to enforce this Rule. Due to timing of the sampling for TOC stated in the D/DBPR, OWP needs to assist waterworks owners in meeting this testing deadline.

This working memo addresses a "Catch-22" contained in what appears to be conflicting information between two specific sections of the rule. This information is contained in a summary of the regulation. Also provided is a specific recommendation for technical assistance to be provided to waterworks.

A summary of requirements found in the D/DBPR is attached. A hard copy of the rule is in each Field Office or on their server in PDF format.

References:

40 CFR Part 141-National Primary Drinking Water Regulations, § 141.132 - 141.135

Enhanced Coagulation and Enhanced Precipitative Softening Guidance Manual, EPA 815-R-99-012, May 1999.

SUMMARY OF REGULATION

All waterworks using surface water or groundwater under the direct influence of surface water and using conventional filtration treatment are required to conduct disinfection byproduct precursor monitoring. This monitoring requires collecting raw water (before treatment) and treated water (no later than the point of combined filter effluent turbidity monitoring) TOC samples and an alkalinity sample each month.

Compliance is based on the waterworks meeting one of the alternative compliance criteria found in Paragraph 2 of Section 141.135(b).

If the waterworks cannot meet any of the alternative compliance criteria it must meet the Step 1 TOC reductions found in the 3X3 matrix in Paragraph 3b under Section 141.135(b).

If the waterworks cannot meet any of the Step 1 TOC reductions, it may apply to the state, within three months of the compliance date, to meet the alternative minimum TOC (Step 2) removal requirements.

HOWEVER, in order to be eligible to apply for Step 2, a waterworks must begin Step 1 monitoring 12 months before the compliance date. The compliance date is January 1, 2002 for waterworks that serves 10,000 or more people and January 1, 2004 for all other waterworks.

Application for retroactive alternative minimum TOC (Step 2) removal requirements must be submitted within 3 months of failure to achieve Step 1 removal goals. This application must be based on the results or findings of Step 1 testing conducted prior to the compliance date. Retroactive Step 2 approval may be granted without a violation.

If Step 1 testing begins after the compliance date and the waterworks cannot meet the requirements, a violation exists and the waterworks cannot apply for retroactive Step 2 TOC removal requirements. The waterworks will be in violation of Step 1 requirements until Step 2 requirements are approved.

The inherent "Catch-22" lies in that a waterworks is not required to initiate Step 1 monitoring prior to the compliance date. If it does and fails Step 1 removal requirements, it can apply for retroactive approval of Step 2 removal requirements. Also a violation would not exist.

If Step 1 monitoring begins after the compliance date(s) and the Step 1 removal rate cannot be met, then the waterworks is in violation. The waterworks cannot achieve retroactive approval of Step 2 removal requirements and the waterworks is in violation.

RECOMMENDED TECHNICAL ASSISTANCE TO WATERWORKS

During routine inspections, the Department should notify the waterworks of our interpretation of the proposed regulations. We should provide waterworks owners and operators with guidance that they initiate Step 1 TOC removal monitoring 12 months prior to the compliance date and apply for retroactive Step 2 removal requirements, if needed, within 3 months following the compliance date. Thus, the waterworks will remain in compliance and avoid a possible violation.

GENERAL QUESTIONS AND ANSWERS

1. Will the Division of Consolidated Laboratory Services provide testing of TOC samples?

   Yes, Monte Waugh has discussed this with DCLS and they are willing to provide this service.

2. a. When a treatment plant practices recycling to the head of the plant, what is considered the source water for TOC testing? Does the plant test: (1) only the raw water, before any chemical addition, or (2) the combined recycle and raw water before any further chemical addition (realizing that the recycle will contain residual chemicals), or (3) both, independently and average the results, take the highest results or proportion the results based on flow?

   Response from EPA Region III:

   Source water TOC samples are suppose to be taken prior to any treatment (including the use of oxidants). That means before any recycled water is added to the mix. If it is physically impossible to sample prior to the addition of recycled water, then that's a trickier issue. That might have to be decided on a case-by-case basis.

b. Source water is to be tested without the recycle. Does this mean the recycle is not considered source water and is not to be tested for TOC at all? Is there any concentrating of TOC in the recycle that we need to be concerned with or testing for?

Response from EPA Region III:

Recycled water may cause the source water TOC level to increase or decrease (that might vary from system to system). The TOC contribution is obviously based on the level of TOC that was trapped in the filter media (and then released during backwashing) and the volume of recycled water. I feel systems should monitor prior to the point where the recycle comes and not consider the recycled water as source water (at least in this case). This would be the most conservative approach. I don't think there is a need to required monitoring of the recycled TOC level (the system might want to do it for information sake, but it is not required on a federal level).

3. Is the treated water TOC to be collected at the end of the sedimentation basin or after filtration?

Routine monitoring requirements found in Section 141.132 d (1) Monitoring Requirements for Disinfection Byproducts Precursors (DBPP) state that waterworks using conventional filtration "must monitor each treatment plant for TOC no later than the point of combined filter effluent turbidity monitoring and representative of the treated water." This section also requires the collection of the raw water TOC before any treatment ("paired" samples") and the collection of a raw water alkalinity sample before any treatment.

4. a. When the D/DBP Rule states the TOC sample is to be taken "no later than the point of combined filter effluent turbidity monitoring", does this mean the point is before any oxidant addition? May the sample be taken at the end of a filter clearwell, where chlorine is added before entering the plant clearwell? If the plant has two filter clearwells, do they collect the TOC sample from each and average the results, collect from one in alternating months, collect from the same one each month and state that it is typical? If the filters discharge to the plant clearwell and chlorine and lime are added at the head of the clearwell, will the waterworks have to sample each filter effluent before the clearwell independently or a composite sample from all of the filters? Or should they only collect the sample before the filter and lose the benefit of the filter in the TOC reduction?

Response from EPA Region III:

~~Treated water TOC must be taken prior to the addition of continuous disinfection. That point will vary from system to system.~~ If there is no "combined" effluent, then a weighted average will be necessary. All the effluent points ~~(prior to continuous disinfection)~~ must be sampled and then average out based on the volume of water coming out of each. ~~If it is physically impossible to monitor combined filter effluent prior to continuous disinfection, then the sampling point gets moved back (or forward depending on your perspective) to the first point available prior to continuous disinfection. This could mean the settled water effluent and it will result in a lower TOC reduction level, but that's what has to be done.~~

Paraphrased response from EPA Headquarters via E-mail dated 10/12/00:

The requirement in §141.134(d) that the treated water TOC must be taken "prior to continuous disinfection" is in error. This was left over from the proposal when EPA was not going to allow CT credit until the system had removed TOC. The final Rule removed the provision and §141.132 was corrected but §141.134(d) was missed.

b. Page 3-2 of the Enhanced Coagulation and Enhanced Precipitative Softening Guidance Manual states "the presence of oxidant in the treated water TOC sample, however, is acceptable." What level of oxidant is acceptable, if the treated water TOC must be taken prior to the addition of continuous disinfection?

Response from EPA Region III:

The only reason the manual states that the presence of an oxidant is acceptable in a treated water TOC sample is for practical purposes. Most plants use an oxidant at the beginning of the treatment train which can lead to the oxidant being present in the CFE. Don't expect the levels to be very high and EPA did not set a limit. If the levels are high, the system might have DBP problems and will have to make changes to compensate. One of the key points in the Disinfectants/Disinfection Byproducts Rule is that the waterworks must develop and implement a monitoring plan. All waterworks serving more than 3300 people must submit the plan to the state no later than the date of the first report for review. The plan must include at least the following elements:

- Specific locations and schedules for collecting samples for any parameter included in the rule.
- How the waterworks will calculate compliance with MCLs, MRDLs and treatment techniques.
- If approved for monitoring as a consecutive system, or if providing water to a consecutive system the sampling plan must reflect the entire distribution system.

ATTACHMENT

The following is a paraphrase of the various sections of the D/DBPR addressing disinfection byproduct precursor monitoring, compliance, reporting and record-keeping and treatment technique:

Section 141.132(d) – Monitoring (see also Section 141.132(f))

1. Requires all waterworks using surface water or groundwater under the direct influence of surface water and using conventional filtration treatment to monitor each treatment plant for TOC as follows:
    a. Sample no later than the point of combined filter turbidity monitoring and representative of the treated water.
    b. Sample at the source water prior to any treatment at the same time as monitoring the treated water.
    c. These are referred to as “paired samples.”
2. Also, at the same time the “paired samples” are collected, a raw water alkalinity is also to be collected, prior to any treatment.
3. Routine samples are to be collected once per month/plant at a time representative of normal operating conditions and influent water quality.
4. These samples may be reduced under the following conditions:
    a. Average treated water TOC of less than 2.0 mg/l for two consecutive years, or
    b. Average treated water TOC of less than 1.0 mg/l for one year
5. The reduced samples, consisting of one paired sample and one raw water alkalinity sample, are to be collected once per quarter/plant.
6. Waterworks must revert to routine samples in the month following the quarter when the annual average treated water TOC ≥2.0 mg/l.

Section 141.132(f) - Monitoring Plan

1. All waterworks must develop and implement a monitoring plan.
2. All waterworks, serving more than 3300 people, must submit a monitoring plan to the state no later than the first monitoring report review deadline. All other waterworks must maintain a plan and make it available for inspection by the state and the general public no later than 30 days following the compliance date.
3. The plan must include the following elements:
    a. Specific locations and schedules for collecting samples for any parameter included in the rule.
    b. Methods used for calculating compliance with MCL’s, MRDL’s and treatment techniques.

Section 141.133(d) – Compliance

1. Compliance must be determined as specified in Section 141.135(b).

2. Waterworks may begin monitoring to determine whether Step 1 TOC removals can be met 12 months prior to the compliance date for the waterworks (1/1/2002 for waterworks serving ≥10,000 population and 1/1/2004 for all other waterworks).

    a. This monitoring is not required and failure to do so is not a violation.

    b. If monitoring is not conducted during this 12-month period, and the waterworks determines in the first 12 months after the compliance date that it is not able to meet the Step 1 requirements in Section 141.135(b)(2) and must therefore apply for alternate minimum TOC removal (Step 2) requirements, the waterworks is not eligible for retroactive approval of alternative minimum TOC removal (Step 2) requirement, as allowed pursuant to Section 141.135(b)(3) and is in violation.

3. Waterworks may apply for alternate minimum TOC removal (Step 2) any time after the compliance date.

Section 141.134 – This section addresses reporting and will not apply until the waterworks has started routine monitoring after 1/1/2002 or 1/1/2004, depending on the size of the waterworks.

Section 141.135 – Treatment Technique for Control of Disinfection Byproduct Precursors.

1. Waterworks using surface water or groundwater under the direct influence of surface water and using conventional filtration treatment must operate with enhanced coagulation or enhanced softening to achieve the TOC percent removal levels specified in “paragraph (b)” of this section unless the waterworks meets at least one of the alternative compliance criteria.

2. Waterworks using surface water or groundwater under the direct influence of surface water and using conventional filtration treatment may use the alternative compliance criteria to comply with this section in lieu of complying with “paragraph (b)” of this section. Waterworks must still comply with monitoring requirements in Sec. 141.132(d).

    a. The waterworks' source water TOC level is less than 2.0 mg/L, calculated quarterly as a running annual average.

    b. The waterworks' treated water TOC level is less than 2.0 mg/L, calculated quarterly as a running annual average.

    c. The waterworks' source water TOC level is less than 4.0 mg/L, calculated quarterly as a running annual average; the source water alkalinity is greater than 60 mg/L (as $CaCO_3$), calculated quarterly as a running annual average; and either the TTHM and HAA5 running annual averages are no greater than 0.040 mg/L and 0.030 mg/L, respectively; or prior to the effective date for compliance, the waterworks has made a clear and irrevocable financial commitment not later than the effective date for compliance to use of technologies that will limit the levels of TTHMs and HAA5 to no more than 0.040 mg/L and 0.030 mg/L, respectively. Waterworks must submit evidence of a clear and irrevocable financial commitment, in addition to a schedule containing milestones and periodic progress reports for installation and operation of appropriate technologies, to the state for approval not later than the effective date for compliance. These technologies must be installed and operating no later than June 16, 2005. Failure to install and operate these technologies by the date in the approved schedule will constitute a violation of National Primary Drinking Water Regulations.

d. The TTHM and HAA5 running annual averages are no greater than 0.040 mg/L and 0.030 mg/L, respectively, and the waterworks uses only chlorine for primary disinfection and maintenance of a residual in the distribution system.

e. The waterworks' source water SUVA, prior to any treatment, is less than or equal to 2.0 L/mg-m, calculated quarterly as a running annual average.

f. The waterworks' finished water SUVA, measured monthly, is less than or equal to 2.0 L/mg-m, calculated quarterly as a running annual average.

3. "Paragraph (b)" – Enhanced Coagulation and Enhanced Softening Performance Requirements.

a. Waterworks must achieve the percent reduction of TOC specified in the next paragraph between the source water and the combined filter effluent, unless the state approves a waterworks' request for alternate minimum TOC removal (Step 2) requirements listed below.

b. Required Step 1 TOC reductions, indicated in Table 1, are based upon specified source water parameters.

Table 1

Step 1 Required Removal of TOC by Enhanced Coagulation and Enhanced Softening for Waterworks Using Conventional Treatment [1]

Source-water TOC, mg/L	Source-water alkalinity, mg/L as $CaCO_3$		
	0-60	≥60-120	>120
>2.0-4.0	35.0%	25.0%	15.0%
>4.0-8.0	45.0%	35.0%	25.0%
>8.0	50.0%	40.0%	30.0%

[1] Waterworks meeting at least one of the conditions in paragraph 2 above are not required to operate with enhanced coagulation.

c. Within three months of failure to achieve the TOC removals required by the above paragraph, waterworks using surface water or groundwater under the direct influence of surface water and using conventional treatment systems that cannot achieve the Step 1 TOC removals required by the above paragraph due to water quality parameters or operational constraints must apply to the state for approval of alternative minimum TOC (Step 2) removal requirements submitted by the waterworks. If the state approves the alternative minimum TOC removal (Step 2) requirements, the state may make those requirements retroactive for the purposes of determining compliance. Until the state approves the alternate minimum TOC removal (Step 2) requirements, waterworks must meet the Step 1 TOC removals contained in the above paragraph.

d. The alternate minimum TOC removal (Step 2) requirements.

i) Applications made to the state by enhanced coagulation waterworks for approval of alternative minimum TOC removal (Step 2) requirements must include, as a minimum, results of bench- or pilot-scale testing conducted under the following paragraph and used to determine the alternate enhanced coagulation level.

ii) Alternate enhanced coagulation level is defined as coagulation at a coagulant dose and pH as determined by the method described in the following paragraphs such that an incremental addition of 10 mg/L of alum (as aluminum) (or equivalent amount of ferric salt) results in a TOC removal of ≤0.3 mg/L. The percent removal of TOC at this point on the "TOC removal versus coagulant dose" curve is defined as the minimum TOC removal required for the waterworks. Once approved by the state, this minimum requirement supersedes the minimum TOC removal required by the table in Paragraph 3b above. This requirement will be effective until such time as the state approves a new value, based on the results of a new bench- and pilot-scale test. Failure to achieve state-set alternative minimum TOC removal levels is a violation of National Primary Drinking Water Regulations.

iii) Bench- or pilot-scale testing of enhanced coagulation must be conducted by using representative water samples and adding 10 mg/L increments of alum (as aluminum) (or equivalent amounts of ferric salt) until the pH is reduced to a level less than or equal to the enhanced coagulation Step 2 target pH shown in Table 2:

Table 2

Enhanced Coagulation Step 2 target pH

Alkalinity (mg/L as $CaCO_3$)	Target pH
0-60	5.5
>60-120	6.3
>120-240	7.0
>240	7.5

iv) For water with an alkalinity of less than 60 mg/L for which addition of small amounts of alum or equivalent addition of iron coagulant drives the pH below 5.5 before significant TOC removal occurs, the waterworks must add necessary chemicals to maintain the pH between 5.3 and 5.7 in samples until the TOC removal of 0.3 mg/L per 10 mg/L alum added (as aluminum) (or equivalent addition of iron coagulant) is reached.

v) The waterworks may operate at any coagulant dose or pH necessary (consistent with other NPDWRs) to achieve the minimum TOC percent removal approved under Paragraph (b)(3) of this section.

vi) If the TOC removal is consistently less than 0.3 mg/L of TOC per 10 mg/L of incremental alum dose (as aluminum) at all dosages of alum (or equivalent addition of iron coagulant), the water is deemed to contain TOC not amenable to enhanced coagulation. The waterworks may then apply to the state for a waiver of enhanced coagulation requirements.

Compliance calculations – This section of the rule lists the calculations used for reporting results to the state.